Thursday, January 26, 2017 3:58 PM

Define - Internal Energy
Thermal Energy
Heat
Temperature
Pressure
mole
Bultzman's Constant

How did I get the balloon inside the Erlenmeyer flask?
How does the drinking duck work? What is the energy source?
How does a refrigerator work?

term	IB definition	Textbook definition
Thermal Energy	same as Heat	same as IB internal energy
Internal Energy U	Sum of potential and kinetic energies of all the particles (atoms +	same as Thermal

	molecules) of an object	

Heat, Q is energy flowing as a result of a difference in temperature, T. Flows from hot to cold. Heat flows until thermal equilibrium - same temperature, T_E.

Temperature, T - How hot something is. The **average** kinetic energy of all the particles in an object.
units: Joules?

Boltzmann's constant - 1.38×10^{23} J/K

For an ideal gas

$\overline{E}_k = 3/2\ k_b T$
average kinetic energy of all the particles
k_b is Boltzmann's constant 1.38×10^{23} J/K
T is temperature in Kelvin, K.

(this is just a unit conversion)

$\overline{E}_k = 1/2\ m v_{rms}^2$
m is the molecular mass = molar mass/mole
mole = 6.02×10^{23} particles/mole
v_{rms} is the root mean square velocity
(kind of like average)

average   3, 2, 4 = 3
root mean square = root((9+4+16)/3)
sqrt(29/3)=3.109126351029605

What is Celsius scale based on?
Water - pure water freezes at 0ºC and boils at 100ºC at standard pressure (101.3 kPa)
If you increase the pressure - the melting point lowers and the boiling point increases.

Kelvin - based on Celsius scale and water for iterations but based on absolute zero for zero Kelvin.
absolute zero = -273ºC and is where the kinetic energy of the particles =0 (impossible give Heisenberg Uncertainty principle, $\Delta p \Delta x \geq h/4\pi$)

Specific Heat Capacity, c
Field Trip - tropical island - sand is hot in the day but cools off quickly at night
water stays at the same temperature
what's the deal?

1. Ocean is big - more mass requires more energy to change the temperature, Q/m proportional to the change in T
2. the amount of heat required to change the temperature is also dependent on the material, c.

Specific heat capacity, c is the energy required to

change the temperature of 1kg of the substance by 1ºC or 1K

Heat capacity, also c is the energy to change the temperature of a sample by 1ºC or K.

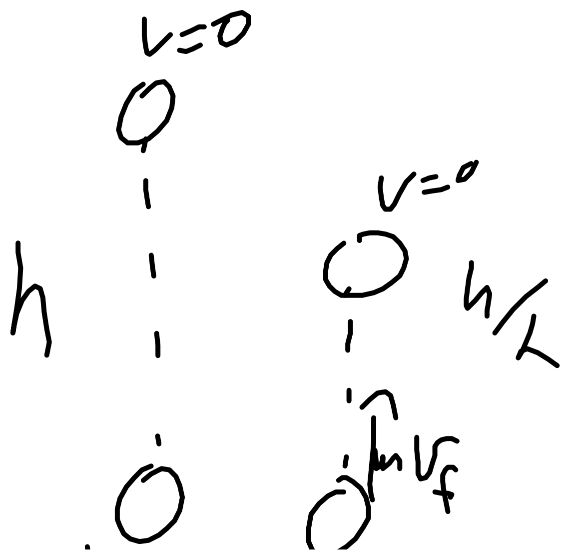
table of values on p248
water c=4180J/kgºC
sand c is about 500 J/kgºC

eg. if you put 500g of water and sand separately on hotplates, if after a couple of minutes, they get 6000J of energy, if they both started at 21ºC, what is their final temperature?

$Q=mc\Delta T$

Q is heat in Joules,
m is mass, in kg
c is specific heat capacity, in J/kgºC
ΔT is change in temperature, in ºC or K.

p247-248 Q1-8



$mg\frac{h}{2} = \frac{1}{2} m v_f^2$

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$$v_f = \sqrt{gh}$$

$$mgh = \frac{1}{2} m v_i^2$$

$$v_i = \sqrt{2gh}$$

$$\Delta p = p_f - p_i$$ direction change

$$= m\sqrt{gh} + m\sqrt{2gh}$$

$$J = Nm = kg\frac{m}{s^2}\, m = \frac{kg\, m^2}{s^2}$$

$$\frac{J\, s}{kg\, m} = \frac{kg\, m^2}{s^2}\,\frac{s}{kg\, m} = \frac{m}{s}$$

$$mv = (m+M)v_2$$

$$\frac{1}{2}(m+M)v_2^2 = (m+M)gh$$

$$m_1 v_1 = m_2 v_2$$

$$\frac{1}{2} m_1 v_1^2 \overset{?}{=} \frac{1}{2} m_2 v_2^2$$

$$\downarrow \quad \uparrow \qquad\qquad \uparrow \quad \downarrow$$